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Statement of inventorship and of right to grant of a patent

The Patent Office
Cardiff Road
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1. Your reference
2698001

30 MAR 2000

2. Patent Application Number
accompanying application reference 2698001

0007755.2

3. Full name of the or each applicant

Canon Kabushiki Kaisha

4. Title of the invention

MACHINE INTERFACE

5. State how the applicant(s) derived the right from the inventor(s) to be granted a patent

By virtue of the employment of the inventor by Canon Research Centre Europe Ltd, and by virtue of an agreement between Canon Research Centre Europe Ltd and Canon Kabushiki Kaisha dated 1 January 1994

6. How many, if any additional Patents Forms 7/77 are attached to this form?

None

7. I/We believe that the person(s) named over the page (and on any extra copies of this form) is/are the inventor(s) of the invention which the above patent application relates to.

Signature BERESFORD & Co Date 30 March 2000

8. Name and daytime telephone number of person to contact in the United Kingdom

John David COLLINS

Tel: 0171-831-2290

Patents Form 1/77

7. If this application is divided or otherwise derived from an earlier UK application give details

Number of earlier application | Date of filing

8. Is a statement of inventorship and or right to grant of a patent required in support of this request?

YES

9. Enter the number of sheets for any of the following items you are filing with this form.

0	Continuation sheets of this form
33	Description
8	Claim(s)
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	Priority documents
	Translations of priority documents
1 + 1 copy	Statement of inventorship and right to grant of a patent *(Patents form 7/77)*
	Request for preliminary examination and search *(Patents Form 9/77)*
	Request for Substantive Examination *(Patents Form 10/77)*
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11. I/We request the grant of a patent on the basis of this application

Signature Beresford & Co BERESFORD & Co Date 30 March 2000

12. Name and daytime telephone number of person to contact in the United Kingdom John David COLLINS

Tel:0171-831-2290

31MAR00 E525922-1 D02917
P01/7700 0.00-0007755.2

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THE PATENT OFFICE
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The Patent Office

Request for grant of a patent

The Patent Office
Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference
2698001

2. Patent Application Numbe **0007755.2** 30 MAR 2000

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

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00363010008

Patents ADP number *(if known)*

If the applicant is a corporate body, give the country/state of its incorporation — Country: **JAPAN** PR
State:

4. Title of the invention
MACHINE INTERFACE

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Patents ADP number 1826001

6. Priority details

Country	Priority application number	Date of filing

Patents Form 7/77

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MACHINE INTERFACE

The present invention generally relates to a machine interface to allow a user to select a machine operation from amongst a plurality of possible machine operations.

A great deal of effort has been expended in the prior art in order to solve the problem of how to interface a machine to a user to enable a user to more readily control the functioning of a machine.

When there are a plurality of possible machine operations which can be carried out and a user cannot uniquely and immediately identify the operation which the user requires to be carried out, it becomes a problem as to how to interface the machine to the user to enable a machine to quickly and efficiently select a desired machine operation. For example, when accessing a database which contains retrievable information, a user may not know the exact identity of the data which is required, e.g. the file name of a picture or a document. The problem is thus how to interact with the user to extract the necessary information to identify a required record.

This problem is also applicable to directing incoming calls in a call centre. In such a system, a user wishes for a call to be routed to a particular destination but that destination is not known. Thus in order to arrive at the target destination, a user must be prompted to input information. This is typically achieved by asking questions of the user in order to extract the necessary information.

In a machine interface which uses such a dialogue between a machine and a user, the user may often require to access the same machine operation, e.g. the same database record, or have the call directed to the same location. However, in order to return to the same point in a dialogue between the machine and the user, it is necessary for the user to repeat the dialogue. This can be a tedious operation for the user.

One aspect of the present invention therefore overcomes the problem of the prior art of interfacing a machine of a user wherein a dialogue is entered into between the machine and the user in order to extract information from the user to identify a machine operation which the user wishes to implement. In accordance with the present invention a position in the dialogue between the user and

the machine can be bookmarked either automatically or manually by the user. The bookmark comprises a bookmark identifier which identifies a set of data which has been arrived at at a point in the dialogue between the user and the machine. The term bookmark refers to any machine readable label, flag, marker or identifier.

In one embodiment, the bookmarking can take place automatically when a machine operation is executed after selection by the user. The bookmark comprises a set of data derived from an initial input from the user. The machine operation which was finally selected starting from the initial user input is linked to a set of data derived from the initial user input so that when the user once again generates a similar initial user input the user can immediately cause the desired machine operation to be executed.

In one embodiment, scores for each of the machine operations is stored, where the scores indicate the likelihood that the user will select a corresponding machine operation. Also scores for the or each keyword for each machine operation are stored, where the scores indicate the likelihood that a user wishes to select a machine operation having caused a keyword to be input.

When a user generates an input, keywords are determined using the input and these are used to look up corresponding scores which are then used to adjust the scores for the machine operations. The adjusted scores for the machine operations are then used to identify a machine operation to be executed. The scores for the keywords are also adjusted using the bookmark identifier.

In an alternative embodiment of the present invention, the user can manually enter a bookmark at an appropriate position in the dialogue with the machine. The manual bookmarking operation includes the inputting of a bookmark instruction and a bookmark identifier. In response to the bookmark instruction, the current set of data determined from the dialogue is stored identified by the bookmark identifier.

In an embodiment of the present invention, the set of data can comprise keywords which can be used to look up scores for the keywords for each machine operation in order to modify stored scores for machine operations. Alternatively, the set of data can comprise a set of scores for the machine operations as modified following the input of the keywords. Either of these will result in a return to a position in the dialogue between the

machine and the user marked by the bookmark.

In another embodiment of the present invention, the set of data comprises pieces of input information. When the number of pieces of input information match the required number, an appropriate machine operation can then be executed.

In the dialogue between the user and the machine, the questions output to the user in order to extract information from the user can be determined based upon previous answers received from the user. Alternatively, the next question to be output to the user can simply be selected from a list of questions.

In the present invention, the machine operation can comprise any operation which can be carried out by a machine such as the retrieval of data, e.g. text, audio, video and images, or the execution of an instruction such as the routing of incoming calls in a call centre, the printing of a document, or the transmission of a facsimile. Thus a machine operation can comprise any event which a user wishes to take place.

In an embodiment of the present invention, the plurality

of questions for output to the user are stored questions which comprise a library of questions aimed at extracting a response from the user which will enable the system to uniquely identify the machine operation which a user wishes to select. The stored questions can thus be tailored to provide the most efficient selection of machine operations.

In an embodiment of the present invention, the stored questions include expected answers. Any specified answer can have associated with it an identifier for a corresponding machine operation which is to be carried out in response to the input of the specified answer. Thus, each machine operation can have associated with it a "final" question which will allow the unique identification of the machine operation as the selected machine operation. The expected answers can have keywords associated therewith to allow for keyword matching with keywords for the target machine operations. Alternatively, instructions can be stored in association with the expected answers to extract keywords from the questions.

In another embodiment of the present invention, a machine operation is carried out in response to an answer when

the score for the machine operation is significantly different from the scores for other machine operations: thus indicating the unique identification of the machine operation. For example, the score for a machine operation may be required to reach a threshold level greater than the other scores by a threshold amount.

The present invention is particularly suited to a dialogue system in which a dialogue is entered into between a user and a machine in order to achieve the implementation of the machine operation. The present invention is particularly suited, although not limited to, implementation in a spoken dialogue system in which the questions are generated as a speech input and the answers are received as speech and processed by a speech recognizer.

The present invention can be implemented by dedicated hardware or by a suitably programmed processing apparatus, e.g. a programmed general purpose computer. The present invention thus encompasses computer program code for controlling a processor in a machine, e.g. in a computer, to carry out the method. The present invention thus encompasses providing the computer code to the processing apparatus in any conventional form, such as:

as a signal, e.g. an electrical signal carried over a communications network such as the Internet, or on a storage medium such as a floppy disk, CD ROM, magnetic tape, or solid state memory device. The computer program code can be provided on any suitable carrier medium to the processing apparatus to be loaded in the processing apparatus to implement the method.

Embodiments of the present invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of a first embodiment of the present invention;

Figure 2 is a schematic diagram of an implementation of the first embodiment of the present invention on a general purpose computer;

Figure 3 is a flow diagram illustrating the method of the first embodiment of the present invention;

Figure 4 is a schematic diagram of a second embodiment of the present invention;

Figure 5 is a schematic diagram of an implementation of the second embodiment of the present invention on a general purpose computer;

Figure 6 is a flow diagram of the method of operation of the second embodiment of the present

invention;

Figure 7A is a schematic illustration of a question data structure;

Figure 7B is a schematic illustration of a "final" question data structure; and

Figure 8 is a schematic diagram of the hierarchical classifications of records in accordance with an embodiment of the present invention.

A first embodiment of the present invention will now be described with reference to Figures 1 to 3.

This first embodiment of the present invention comprises a manual bookmarking system wherein a user who enters into a dialogue with a machine is able to manually bookmark the position in the dialogue to enable the user to return to that position in the dialogue simply by inputting the bookmark.

Figure 1 illustrates schematically this first embodiment of the present invention. The user is able to answer questions and enter bookmark information using the user input device 1. All input data comprising answers to questions and bookmark information is received by an input translator 2. The input translator 2 translates

the input data either into input data to be stored in the data structure which is stored in an input data store 4, or identifies uniquely a record which can then be retrieved from a record database 3 and output on an output device 8. Also, the input translator 2 recognises an input bookmark instruction and stores the current data structure in the bookmark store 5. Further, the input translator 2 recognises a request for retrieval of bookmark data and accesses the stored data structure in the bookmark store 5. This retrieved data structure may enable the input translator 2 to immediately retrieve a record from the record database 3 for output by the output device 8. Alternatively, the retrieved data structure from the bookmark store 5 may simply be input into the input data store 4 in combination with any data structure already formed from input data.

Data within the input data store 4 is used by a question selector 6 in order to select a question from a question database 7 to be output by the output device 8. Thus in this embodiment, questions which are output to a user in order to prompt the user to input more data are selected based on previous input data by the user.

Figure 2 illustrates the implementation of this

embodiment of the present invention on a general purpose computer.

The computer includes an audio input device 20 such as a microphone and suitable analogue-to-digital conversion means in order to input spoken words into the computer. An audio output device 21, such as a loudspeaker, and suitable digital-to-analogue means is provided to generate spoken words comprising questions or output audio data records to a user.

A question database 22 and a record database 23 are provided stored in conventional non-volatile memory means such as a hard disk drive, CD ROM, floppy disk drive or solid state device. A working memory 26 is provided to store data used during the implementation of the system. A program memory 27 is also provided to store the computer program code for the implementation of the system. The working memory 26 and the program memory 27 can be provided on any conventional volatile or non-volatile memory means, e.g. hard disk drive, CD ROM, floppy disk drive or solid state device. The computer program code can be provided to the program memory 27 using any conventional carrier medium. In Figure 2 a floppy disk drive 29 is illustrated. However, any other

carrier medium such as a carrier signal, e.g. an electrical signal on the Internet, or any type of storage medium, e.g. CD ROM, tape device or solid state device can be used.

A processor 25 is provided and comprises the conventional CPU of a general purpose computer. The processor 25 implements various functions by loading and running computer program code stored in the program memory 27. In the present embodiment, the processor 25 implements a speech recognition engine 250 by loading and implementing speech recognition engine code from the program memory 27. This enables the audio input received from the audio input device 20 to be converted into text. The processor 25 also implements an input translator 251 by loading and implementing input translator code from the program memory 27. The input translator receives the output of the speech recognition engine 250.

The processor 25 further implements a question selector 252 by loading and implementing question selector code from the program memory 27. Also the processor 25 implements an audio output driver 253 by loading and implementing audio output driver code from the program memory 27. The audio output driver 253 can cause the

retrieval of audio data as the selected record from the record database 25 by the audio output device 21. In an alternative arrangement, the audio output driver 253 can include text-to-speech synthesiser if the records in the record database 23 comprise text. The text-to-speech synthesiser of the audio output driver 253 can then convert the text to speech data for output by the audio output device 21.

The operation of the system will now be described with reference to the flow diagram of Figure 3.

In step S1 a question is selected for output to the user. In step S2 the selected question is output to the user and in step S3 the machine waits for a user input. When a user input is received, in step S4, the input translator 2 determines whether a bookmark instruction has been received. If not, in step S5 the input translator 2 enters the data and determines in step S6 whether the data structure is sufficient to identify a record. If the data structure does identify a record, in step S7 the record is retrieved from the record database 3 and output to the output device 8. In the implementation illustrated in Figure 2, the record retrieved comprises either an audio file or text which is

converted to audio for output by the audio output device 21.

If in step S6 the input translator 2 determines that the data structure does not identify a record, in step S1 the question selector 6 selects another question for output to the user.

If in step S4 it is determined by the input translator 2 that a bookmark instruction is received, in step S8 it is determined whether a bookmark retrieval instruction has been received. If the instruction is not a retrieval instruction, in step S11 the input translator 2 determines that a bookmark store instruction has been received and thus the current data structure is stored in the bookmark store 5 indexed by the bookmark identifier. The process then returns to step S6 to determine whether the data structure identifies a record.

If in step S8 it is determined that the bookmark instruction received comprises a retrieval instruction, the input translator 2 in step S9 retrieves bookmarked data from the bookmark store 5 using the bookmarked identifier associated with the retrieval instruction. The retrieved data structure is then unified with any

data in the current data structure in step S10 by the input translator 2 by reading data from the input data store 4 and the process returns to step S6 to determine whether the data structure identifies a record.

In this embodiment of the present invention, a user is able to manually request the bookmarking of a position in a dialogue with a machine such that a user can return to that position in the dialogue simply by inputting a bookmark retrieval instruction with an associated bookmark identifier.

In this embodiment of the present invention, the input data can either be taken directly from the data input by the user, or from the question in association with the response by the user. Each expected response can have input data associated with it or the identity of a record which is to be accessed. Thus when an expected answer is received, this can either result in the generation of input data for the selection of the next question, or it can result in the identification of a record for output.

Alternatively, the data structure can be built up by receiving input pieces of information from the user input device 1. The input translator 2 will thus continue to

fill the data structure with pieces of information received until the data structure is complete. The complete data structure will then identify a record which can be retrieved for output.

A second embodiment of the present invention will now be described with reference to Figures 4 to 8.

In the second embodiment of the present invention, the system automatically generates bookmarks from an initial user input. When the user initially inputs data, keywords are extracted from this to be used as bookmarks for a record when this is finally identified and output. Thus the extracted keywords are used to increase scores for the keywords or to add scores for the keywords so that when a user next inputs data which includes the keywords, the probability of quickly identifying the record last identified by the keywords is improved.

Figure 4 is a schematic illustration of the second embodiment of the present invention for accessing records in a database by receiving user input queries and answers to questions generated by the system in order to aid the identification of the desired record.

A user input device 101 receives user input. The user input device 101 will provide text based on the input to an answer translator 102 which interprets the answer by comparing the answer to expected answers to questions which are stored with the questions in a question data structure database 105. If the user input does not match the expected answers for a question which was asked, the user input is passed to a keyword extractor 104 to extract the keywords from the user input. The keywords are then stored in a keyword list storage device 103. If on the other hand the user input matches expected answers, this can result in the answer being translated to simply output a set of keywords associated with the expected answer to the keyword list storage device 103. If an answer which is matched to a user input indicates that the record should be rejected, the identity of the rejected record is stored in a rejected record storage device 106. If the user input matches an answer which has associated with it the identity of a record which is to be selected, i.e. the user input is sufficient to identify a record, the answer translator 102 will access the database for the records 112 in order to cause the record to be retrieved and output to an output device 111. Each record of the database 112 has a score stored in an initial record scores database 113. The score for

each record indicates the likelihood that a user will wish to access the record. The initial scores can be used to identify popular records which are often accessed by users.

A keyword scores database 108 is provided which stores a score for keywords for each record. Thus, for example, for a keyword "book", scores for the keyword for records which have information on or relate to books will be high.

A score adjustment engine 107 is provided to read the keyword list from the keyword list storage device 103 and to identify if any records have been rejected by reading the rejected record storage device 106. If any records have been rejected, their score is set to zero indicating that the user does not wish to access these records.

The score adjustment engine 107 accesses the keyword scores database 108 using the keywords in the keyword list read from the keyword storage device 103 in order to determine keyword scores for records. The score adjustment engine 107 also accesses current scores for records from a record scores storage device 109. Initially, the current scores in the record scores

storage device 109 can be set to the initial record scores from the initial record scores database 113. The score adjustment engine then adjusts the current scores for each record in dependence upon the scores determined for each keyword for each record. The adjusted score is then stored as the current score for each record in the record scores storage device 9.

The score adjustment engine 107 also receives initial keywords identified from an initial input from a user by the answer translator 102. The initial keywords are used as bookmarks in order to adjust the keyword scores for the records in the keyword scores database 108.

When a record has not been identified as a desired record as a result of a user input, the system requires more information to enable it to identify a desired record. This information is obtained by asking the user a next question retrieved from the question data structure database 105. The next question to be selected to be retrieved from the question data structure database 105 is determined by a question selector 110 which selects the question on the basis of the current scores for each record stored in the record scores storage device 109. Once a question has been selected by the question

selector 110, it is retrieved from the question data structure database 105 and output to the output device 110.

Thus the embodiment of the present invention will continue to ask questions selected by the question selector 110 of the user in order to extract more keywords which will help to identify a desired record by adjusting the scores appropriately for the records.

Figure 5 is a schematic diagram of an implementation of the second embodiment of the present invention in a general purpose computer which interfaces to a user using speech.

The computer includes an audio input device 120 such as a microphone and suitable analogue-to-digital conversion means in order to input spoken words into the computer. An audio output device 121 such as a loudspeaker and suitable digital-to-analogue means is provided to generate spoken words comprising questions or output audio data records to a user.

A question database 122, a record database 123 and a keyword database 124 are provided stored in conventional

non-volatile memory means such as a hard disk drive, CD ROM, floppy disk drive or solid state device. A working memory 126 is provided to store data used during the implementation of the system. A program memory 127 is also provided to store the computer program code for the implementation of the system. The working memory 126 and the program memory 127 can be provided on any conventional volatile or non-volatile memory means, e.g. hard disk drive, CD ROM, floppy disk drive, or solid state device. The computer program code can be provided to the program memory 127 using any conventional carrier medium. In Figure 5 a floppy disk 129 is illustrated. However, any other carrier medium such as a carrier signal, e.g. an electrical signal carried over the Internet, or any type of storage medium, e.g. CD ROM, tape device, or solid state device can be used.

A processor 125 is provided and comprises the conventional CPU of a general purpose computer. The processor 125 implements various functions by loading and running computer program code stored in the program memory 127. In the present embodiment, the processor 125 implements a speech recognition engine 1250 by loading and implementing speech recognition engine code from the program memory 127. This enables the audio input

received from the audio input device 120 to be converted into text. The processor 125 also implements an answer translator 1251 by loading and implementing answer translator code from the program memory 127. The answer translator 1251 receives the output of the speech recognition engine 1250.

The processor 125 further implements a keyword extractor 1252 by loading and implementing keyword extractor code from the program memory 127. Also the processor 125 implements a score adjustment engine 1253 by loading and implementing score adjustment engine code from the program memory 127. Further, the processor 125 implements a question selector 1254 by loading and implementing question selector code from the program memory 127. Also, the processor 125 implements an audio output driver 1256 by loading and implementing audio output driver code from the program memory 127. The audio output driver 1256 can cause the retrieval of audio data as the selected record from the record database 125 for output by the audio output device 121. In an alternative arrangement, the audio output driver 1256 can include a text-to-speech synthesiser if the records for the record database 123 comprise text. The text-to-speech synthesiser of the output audio driver 1256 can

then convert the text-to-speech data for output by the audio output device 121.

The operation of the system will now be described.

The records of the database of this embodiment comprise audio files in the "wave" file format. Each record is identified by a record number to allow for ease of access.

The question data is formed into question data structures as illustrated in Figures 7A and 7B. Each question is identified by a question number. Associated with the question is a question prompt as an audio file in the "wave" format, e.g. in QUESTION10.WAV. Associated with each question are expected answers. In the embodiment illustrated in Figure 7A, the expected answers are "yes" or "no". The question output in this example could be an audio question "Do you want pop music?". If the user answers "yes", associated with the expected answer "yes" are the keywords "pop music" and "rock music". If the user answers "no", associated with the expected answer "no" is an instruction to reject three records as not being records which will be desired by the user, i.e. records 18, 22 and 36. This list of rejected records is

stored in the rejected record list. The question data structure also includes an indication of the topic of the question which in this case generally comprises the topic "music".

The question data structure illustrated in Figure 7A comprises a question data structure which does not result in the selection of a record as a result of an answer. Instead, the answer will result in the rejection of some records and the input of keywords which can be used to adjust the scores for records which will then be used to select the next question to ask the user.

Figure 7B illustrates another question data structure which is termed the "final" question data structure for a record. The question data structure is the same as that of Figure 7A except in the example given, the question to be output to the user is of course a different audio file related to question number 15. Also the expected answers result in different operations. For example, the question could be "Do you want pop artist 1?", where record number 20 contains a piece of music by pop artist 1. If the answer to this question is "yes", in the question data structure there is an instruction to set the selected record identifier for record number 20.

If on the other hand the answer is "no", the rejected record identifier is set to record number 20.

The other difference between the question data structure of Figure 7A and the question data structure of Figure 7B is that the topic is more narrowly defined as "pop music".

Figure 6 is a flow diagram illustrating the operation of this embodiment of the present invention.

In step S20 an initial question is output to the user. This question can simply be an initial prompt, e.g. "What would you like?" and the scores for the records are set to the initial record scores. In step S21 the system awaits the user input and when this is received, in step S22, the answer translator determines whether the input matches an expected answer. If it does not, in step S24 keywords are extracted from the input. In step S24 it is then determined whether the input is an initial input. If so in step S25 keywords for the initial input are stored to act as bookmarks. Then in step S26 the keywords are added to the keyword list and in step S27 the keywords are used to search in the keyword database the scores for the words for each record. These scores

are then used to determine a revised score for each record.

In step S28 a next question to ask the user is selected using the revised scores for each record. The selected question is then output in step S29 to the user and the process returns to step S21 to await the user input.

In this embodiment the initial scores for the records are set as an initial probability p(x). The scores for keywords stored comprises a probability of a word given a record p(w|x). The probability is thus updated by multiplying the current probability p(x) by the word probability p(w|x).

In order to take into account the possibility that a user changes the target record during the question and answer session, the current probability for records is allowed to decay back towards the initial probability. For example, the new probability can be calculated from:

$$p(x) = (0.2 \times p_i(x) + 0.8 \times p(x)) \times p(w|x)$$

where $p_i(x)$ is the initial probability.

It can be seen that with a decay set by the numbers 0.2 and 0.8, the current probability can be made to decay

towards the initial probability if the word probability does not modify the current probability.

If in step S22 the user's input does match an expected answer, the answer translator, in step S30, translates the input to keywords if the answer has keywords associated with it. Alternatively, if there is an instruction associated with an expected answer to set the selected record identifier to a record number or to set the rejected record identified to a record number, this is done. Then in step S31 it is determined whether the selected record identifier identifies a record. If not, in step S31 it is determined whether the rejected record identifier identifies a record. If not, this means that the answer translator has determined keywords associated with the answer and these are added to the keyword list in step S26 to be used in step S27 to revise the score for each record. The revised score can then be used in step S28 to select the next question to ask a user for output in step S29.

If in step S32 it is determined that there is a record identified by the rejected record identifier, in step S33 the score for the record is fixed to zero and the process to select the next question to ask a user in step S28 is

carried out with the score for the record fixed to zero. If step S33 has been carried out a number of times, there can be a number of rejected records listed for which the scores are fixed to zero. These are listed in the rejected record list to ensure that their scores remain fixed at zero in the current scores used by the question selector to determine the next question to ask a user. If in step S31 it is determined that a record is identified, in step S34 any initial keywords stored in step S25 are stored as keywords for the identified record. Then in step S35 the record is retrieved.

Thus in this embodiment of the present invention the keywords determined from an initial input from the user are used as bookmarks by adding the keywords to keywords for a record which was finally identified as the target record starting from the initial query from the user.

In this embodiment the keywords in the keyword database have probabilities associated with them. Thus in step S34, rather than simply adding keywords to the list, the probabilities for the keywords listed in the keyword database is modified. For example, where the keyword does not appear in the keyword database, the keyword is added to the database with a high probability. If the

keyword is already in the database, its probability is increased. Since probability is used in this embodiment for the words, and since all the probabilities must add up to 1.0, where keywords identified in step S25 have their probabilities increased, probabilities for other words must decrease. A set of probabilities for keywords can be stored as a bookmark to be used for the calculation of probabilities for records. The probabilities for records are themselves used to identify the record being sought by the user.

In this embodiment, any method of selecting a question can be used, e.g. simply by referring to the topics of the questions. Preferably, however, this embodiment of the present invention implements the technique for selecting the question disclosed in a copending UK application by the same assignee filed on 29 March 2000, the contents of which are hereby incorporated by reference. The particular technique for selecting the next question is not an essential feature of the present invention. For example, the next question could simply be selected from a list of questions.

In the foregoing embodiments, probabilities have been described as usable with keywords for records. It is,

however, also possible to bookmark not just the final records to be selected, but also any position in a dialogue. In one embodiment this can be achieved by a hierarchical set of questions so that the probability for the records can be formed into a hierarchical tree as illustrated in Fig. 8.

In Fig. 8 the numbers indicate probabilities for records, and classifications of records. The keywords "music" and "cars" can be used as a third hierarchical level and the keywords "classical", "pop", "British" and "foreign" can be used as keywords at a second hierarchical level of classification. Thus, for instance, after having reached the classification "pop", which identifies two possible records "artist 1" and "artist 2", a user may wish to bookmark this point of the dialogue, e.g. using the spoken word "jack". Thus the bookmark identifier "jack" will identify keywords which, in this example, can be the keywords "music" and "pop". These keywords will have probabilities associated with them which will result in the probabilities for the final records "artist 1" and "artist 2" being adjusted to 0.2 and 0.3 which is higher than the other records.

This enables a user to return to a point in the dialogue

which could then result in a question being asked "Do you want artist 1 or artist 2?". Thus, this position in the dialogue is bookmarked without having to actually bookmark a record. This avoids the user having to reach a midpoint in a dialogue by repeating previous dialogue steps, e.g. answering the question "Do you want music or cars?" and "Do you want classical music or pop music?".

Although the present invention has been described hereinabove with reference to specific embodiments, modifications will be apparent to a skilled person in the art which lie within the spirit and scope of the present invention.

Although in the embodiments probabilities used for words and records, any form of score can be used.

In the second embodiment, a "final" question is used to cause the selection of a record for output. However, the selection of a record for output can alternatively take place by selecting a record which has a score which is significantly high, e.g. as a score above a threshold which is greater than other scores by a threshold amount.

In the first embodiment, the bookmark comprises a spoken

bookmark (a manual bookmark). The bookmark can, however, be manually input in any way, e.g. using a keyboard.

The present invention is applicable to any means by which questions and answers can be conveyed to and from a user to the system. The user interface can comprise speech or text for example.

The present invention is applicable to the selection of any type of machine operation from a number of possible machine operations. For example, the present invention is applicable to the selection of data records for retrieval, e.g. the retrieval of images, text, audio and video. Alternatively, the machine operation can simply comprise the marking or identification of a selected record. Further, the machine operation can be the selection and execution of a spoken dialogue module such as a VoXml file. Also, the present invention is applicable to call centre technology wherein the selected machine operation is the routing of a telephone call or the selection of a service. Further, the present invention is applicable to telephone banking wherein the selection of banking services and banking information can be achieved.

The present invention can be intended to provide bookmarks for individual users and can thus provide individual user profiles.

The present invention can be implemented by dedicated hardware configured to perform the functions of the system.

More preferably, the present invention is implemented in a processing system by computer program code. Such a processing system can be provided in any form of apparatus, such as in a photocopying machine, facsimile machine, mobile telephone, or a general purpose computer.

The present invention thus encompasses program code for controlling a processor to implement a method. The program code can be loaded into the processing system from any conventional carrier medium such as a transient carrier medium (e.g. an electrical signal carrying the program code) or a storage medium, such as a floppy disk drive, CD ROM, magnetic tape device or solid state device.

CLAIMS:

1. A machine having a machine interface to allow a user to select a machine operation, the machine interface comprising:

outputting means for outputting questions to the user;

inputting means for receiving input answers to the questions; and

processing means for determining a set of data from at least one said input answer and for using the set of data to execute a said machine operation and for determining a question for output by said outputting means, said processing means being adapted to store a set of data determined from at least one said input answer identified as a bookmark and to retrieve said set of data when the bookmark identifier is determined from a said input answer.

2. A machine according to claim 1, including keyword determining means for determining keywords using the input answer, wherein said set of data comprises at least one keyword and said bookmark identifier comprises said at least one keyword.

3. A machine according to claim 2, including score

storage means for storing a score for each of a plurality of machine operations, the score indicating the likelihood that the user will select a corresponding machine operation keyword; storage means for storing said at least one keyword and scores for said at least one keyword for each machine operation, said scores indicating the likelihood that a user wishes to select a machine operation having caused a said keyword to be input; said processing means being adapted to use the determined input keywords and said keyword storage means to adjust said scores in said score storage means, to use the adjusted scores to identify said machine operation to be executed, and to adjust the scores for keywords stored in said keyword storage means using said at least one keyword of said bookmark identifier.

4. A machine according to any preceding claim wherein said processing means is adapted to automatically determine said bookmark identifier using the response to an initial question when a said machine operation is selected to be executed.

5. A machine according to any one of claims 1 to 3, wherein said inputting means is adapted to input a bookmark instruction and a said bookmark identifier, said

processing means being responsive to said bookmark instruction to store the current set of data determined from said at least one input answer identified by said bookmark identifier.

6. A machine according to claim 5, as dependent on claim 1, including keyword determining means for determining keywords using the input answers, wherein said set of data comprises at least one keyword.

7. A machine according to claim 6, including score storage means for storing a score of each of a plurality of machine operations, the score indicating the likelihood that the user will select a corresponding machine operation, keyword storage means for storing said at least one keyword and scores for said at least one keyword for each machine operation, said scores indicating the likelihood that a user wishes to select a machine operation having caused a said keyword to be input, said processing means being adapted to use the determined input keywords and said keyword storage means to adjust said scores in said score storage means, to use the adjusted scores to identify said machine operation to be executed, and to adjust the scores for keywords stored in said keyword storage means using said current set of

data identified by said bookmark identifier.

8. A machine according to any preceding claim wherein said processing means is adapted to execute a said machine operation when said set of data uniquely identifies said machine operation.

9. A machine according to claim 1 wherein said processing means is adapted to determine said set of data from pieces of input information.

10. A machine according to claim 9 wherein said processing means is adapted to execute a said machine operation when said set of data is complete.

11. A machine according to any preceding claim wherein said processing means is adapted to determine said set of data by looking up data associated with an output question using the input answer.

12. A machine according to any preceding claim wherein said processing means is adapted to select a question for outputting by said outputting means in dependence upon previous answers received.

13. A machine according to any one of claims 1 to 11 wherein said processing means is adapted to select a question for outputting by said outputting means from a list of questions.

14. A method of providing a machine interface to allow a user to select a machine operation, the method comprising:

outputting questions to the user;

receiving input answers to the questions;

determining a set of data from at least one said input answer;

using the set of data to execute a machine operation or determining and outputting a question to the user;

wherein a set of data determined from at least one input answer identified as a bookmark is stored and said set of data is retrieved when the bookmark identifier is determined from a said input answer.

15. A method according to claim 14 including determining keywords using the input answers, wherein said set of data comprises at least one keyword and said bookmark identifier comprises said at least one keyword.

16. A method according to claim 15 including providing

a store with scores for a plurality of machine operations, each score indicating the likelihood that the user will select a corresponding machine operation; providing a store of said at least one keyword and scores for said at least one keyword for each machine operation, said scores indicating the likelihood that a user wishes to select a machine operation having caused a said keyword input; using the determined input keywords to look up scores stored for keywords to adjust said scores for each machine operation; using the adjusted scores to identify said machine operation to be executed; and adjusting the scores for stored keywords using said at least one keyword of said bookmark identifier.

17. A method according to any one of claims 14 to 16 wherein said bookmark identifier is automatically determined using the response to an initial question when a said machine operation is selected to be executed.

18. A method according to any one of claims 14 to 16 including inputting a bookmark instruction and a said bookmark identifier, wherein the current set of data determined from said at least one input answer identified by said bookmark identifier is stored in response to the input of said bookmark instruction.

19. A method according to claim 18 as dependent on claim 14 including determining keywords using the input answers, wherein said set of data comprises at least one keyword.

20. A method according to claim 19 wherein a score for each of a plurality of machine operations is stored, the score indicating the likelihood that the user will select a corresponding machine operation; said at least one keyword and scores for said at least one keyword for each machine operation are stored, said scores indicating that the likelihood that the user wishes to select a machine operation having caused a said keyword to be input; the determined input keywords are used to look up keyword scores to be used to adjust said scores for said machine operations; the adjusted scores are used to identify said machine operation to be executed; and the stored scores for keywords are adjusted using said current set of data identified by said bookmark identifier.

21. A method according to any one of claims 14 to 20 wherein a said machine operation is executed when said set of data uniquely identifies said machine operation.

22. A method according to claim 14 wherein said set of

data is determined from pieces of input information.

23. A method according to claim 22 wherein a said machine operation is executed when said set of data is complete.

24. A method according to any one of claims 14 to 23 wherein said set of data is determined by looking up data associated with an output question using the input answer.

25. A method according to any one of claims 14 to 24 wherein a question is selected for outputting in dependence upon previous answers received.

26. A method according to any one of claims 14 to 24 wherein a question is selected for outputting from a list of questions.

27. A program code for controlling a processor to implement the method of any one of claims 14 to 26.

28. A carrier medium carrying the program code according to claim 27.

MACHINE INTERFACE

ABSTRACT

A machine interface which allows a user to select a machine operation, outputs questions to a user and receives input answers to the questions. A set of data is determined from at least one input answer and this is used to execute a machine operation. If the machine operation is not executed, a further question is determined for output to the user. A set of data determined from at least one input answer is stored identified as a bookmark and can be retrieved when the bookmark identifier is determined from an input answer.

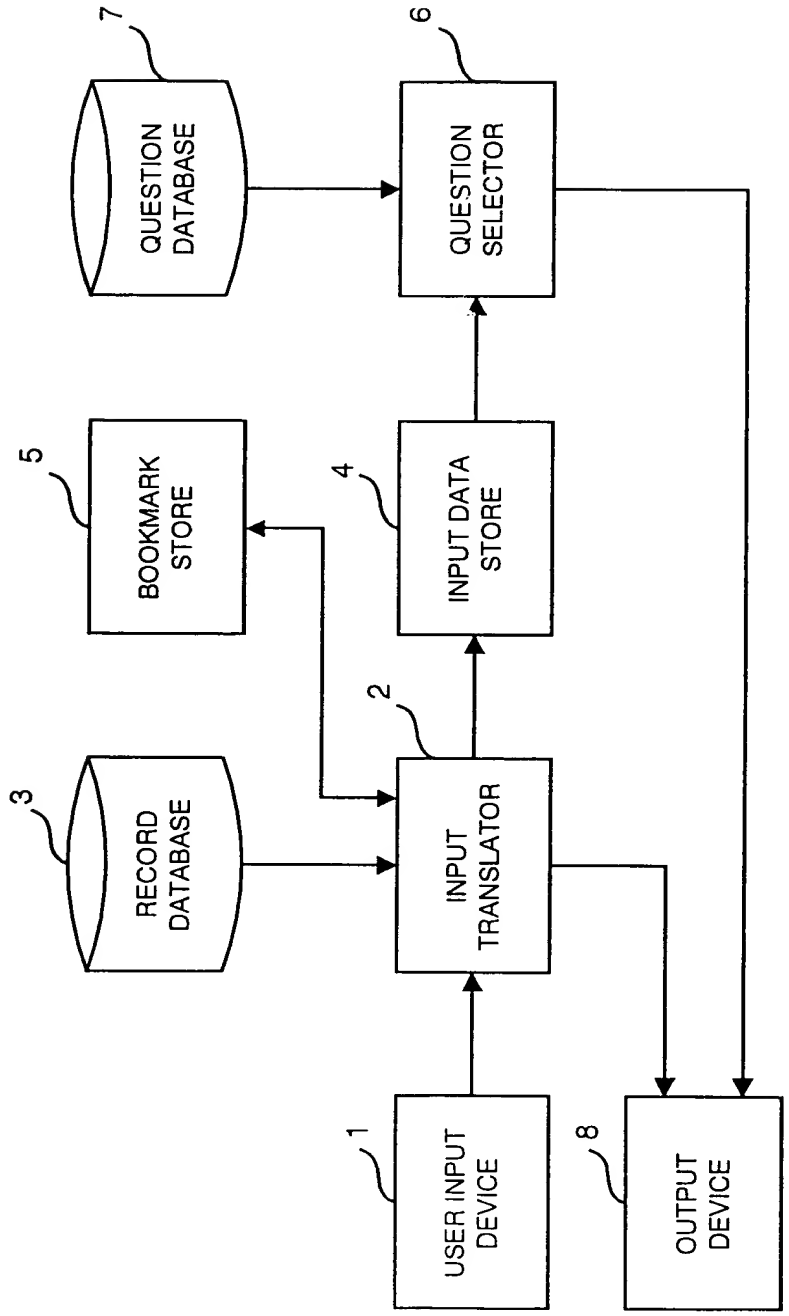
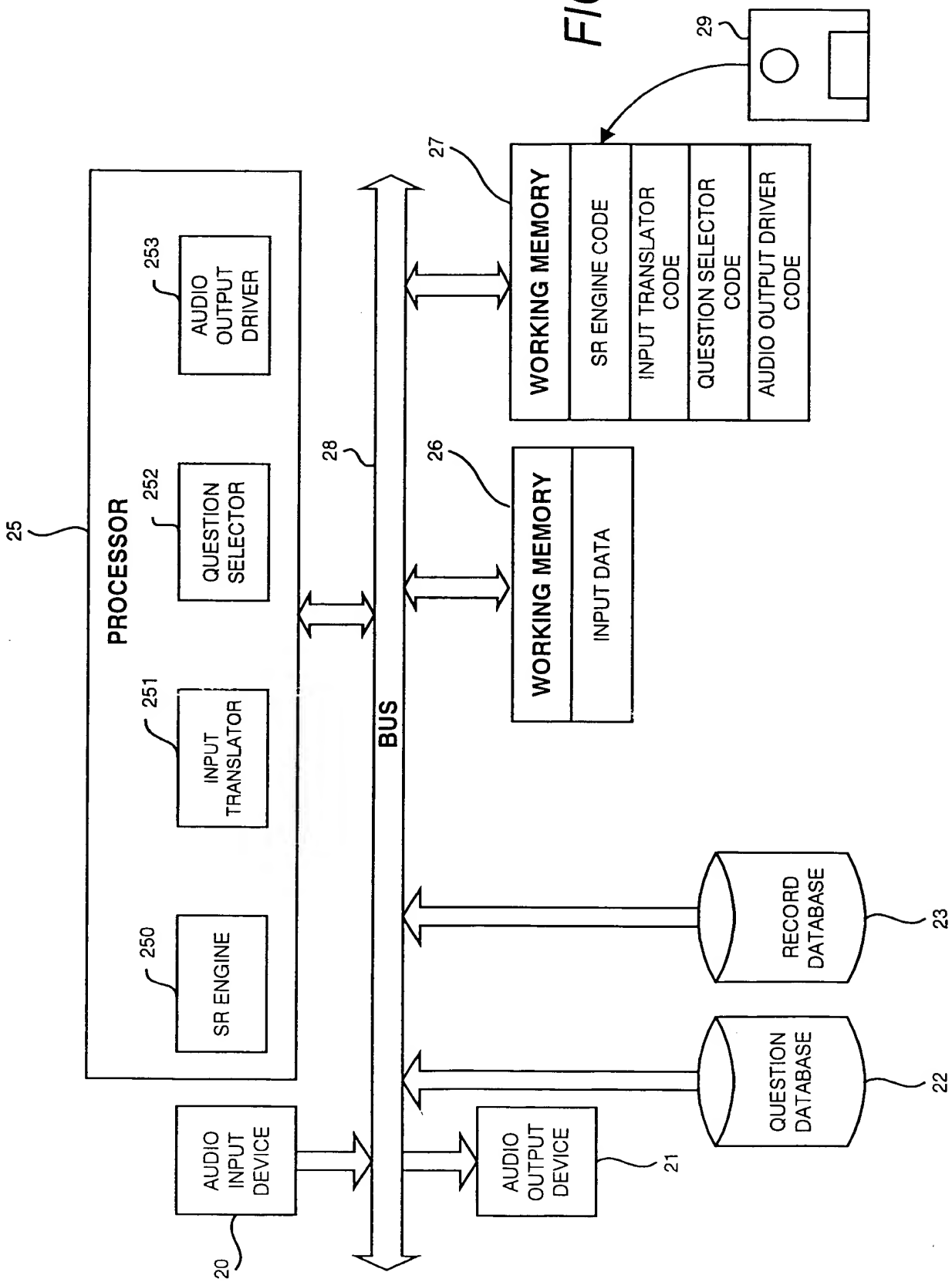

7
QUESTION DATABASE
6
QUESTION SELECTOR
5
BOOKMARK STORE
4
INPUT DATA STORE
2
3
RECORD DATABASE
INPUT TRANSLATOR
1
USER INPUT DEVICE
8
OUTPUT DEVICE

FIG. 1

FIG. 2


29
27
WORKING MEMORY
SR ENGINE CODE
INPUT TRANSLATOR CODE
QUESTION SELECTOR CODE
AUDIO OUTPUT DRIVER CODE
28
26
WORKING MEMORY
INPUT DATA
25
PROCESSOR
253
AUDIO OUTPUT DRIVER
252
QUESTION SELECTOR
251
INPUT TRANSLATOR
250
SR ENGINE
BUS
RECORD DATABASE
23
QUESTION DATABASE
22
AUDIO OUTPUT DEVICE
21
AUDIO INPUT DEVICE
20

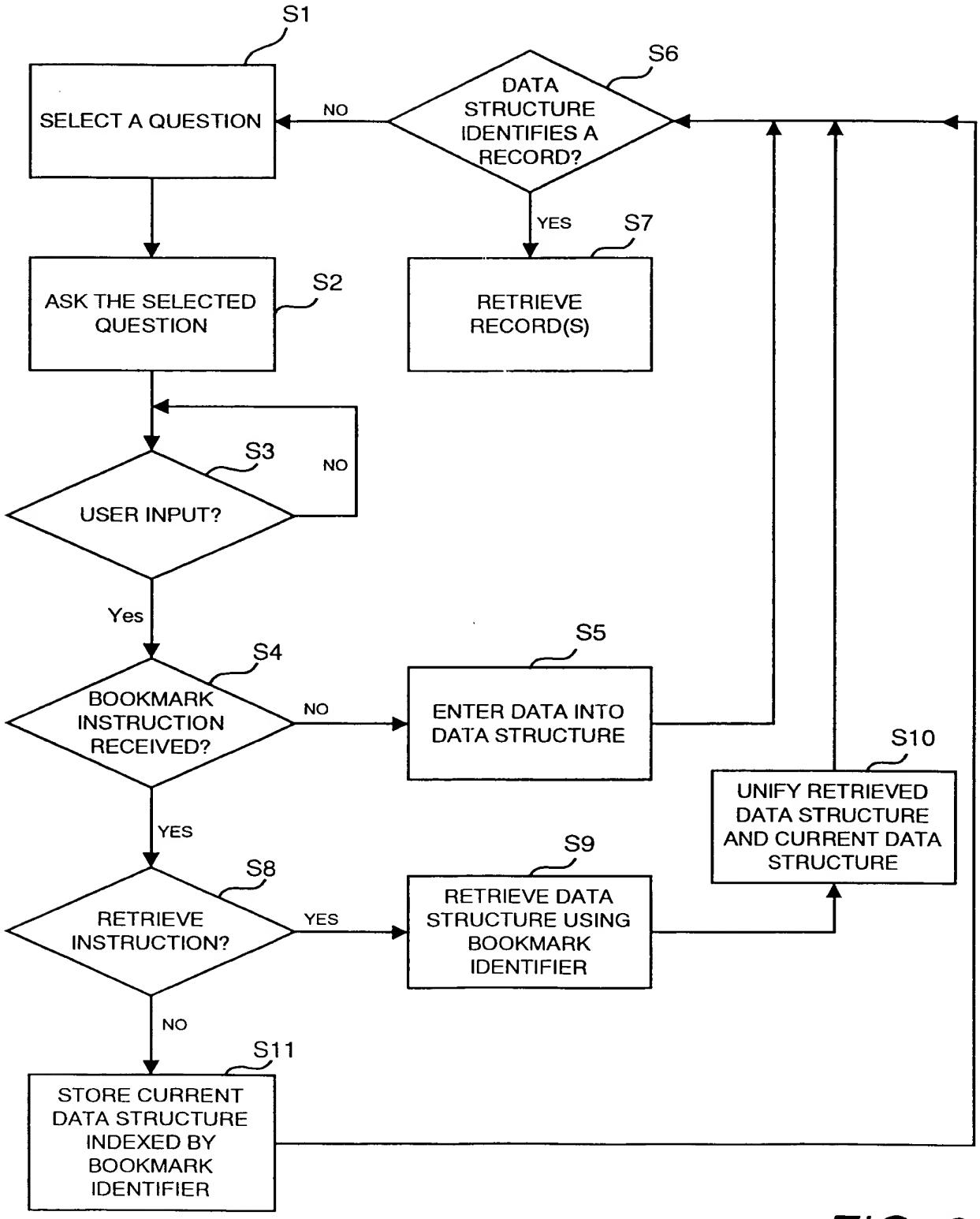

S1
SELECT A QUESTION
S6
DATA STRUCTURE IDENTIFIES A RECORD?
NO
YES
S7
RETRIEVE RECORD(S)
S2
ASK THE SELECTED QUESTION
S3
USER INPUT?
NO
Yes
S4
BOOKMARK INSTRUCTION RECEIVED?
NO
S5
ENTER DATA INTO DATA STRUCTURE
S10
UNIFY RETRIEVED DATA STRUCTURE AND CURRENT DATA STRUCTURE
YES
S8
RETRIEVE INSTRUCTION?
YES
S9
RETRIEVE DATA STRUCTURE USING BOOKMARK IDENTIFIER
NO
S11
STORE CURRENT DATA STRUCTURE INDEXED BY BOOKMARK IDENTIFIER

FIG. 3

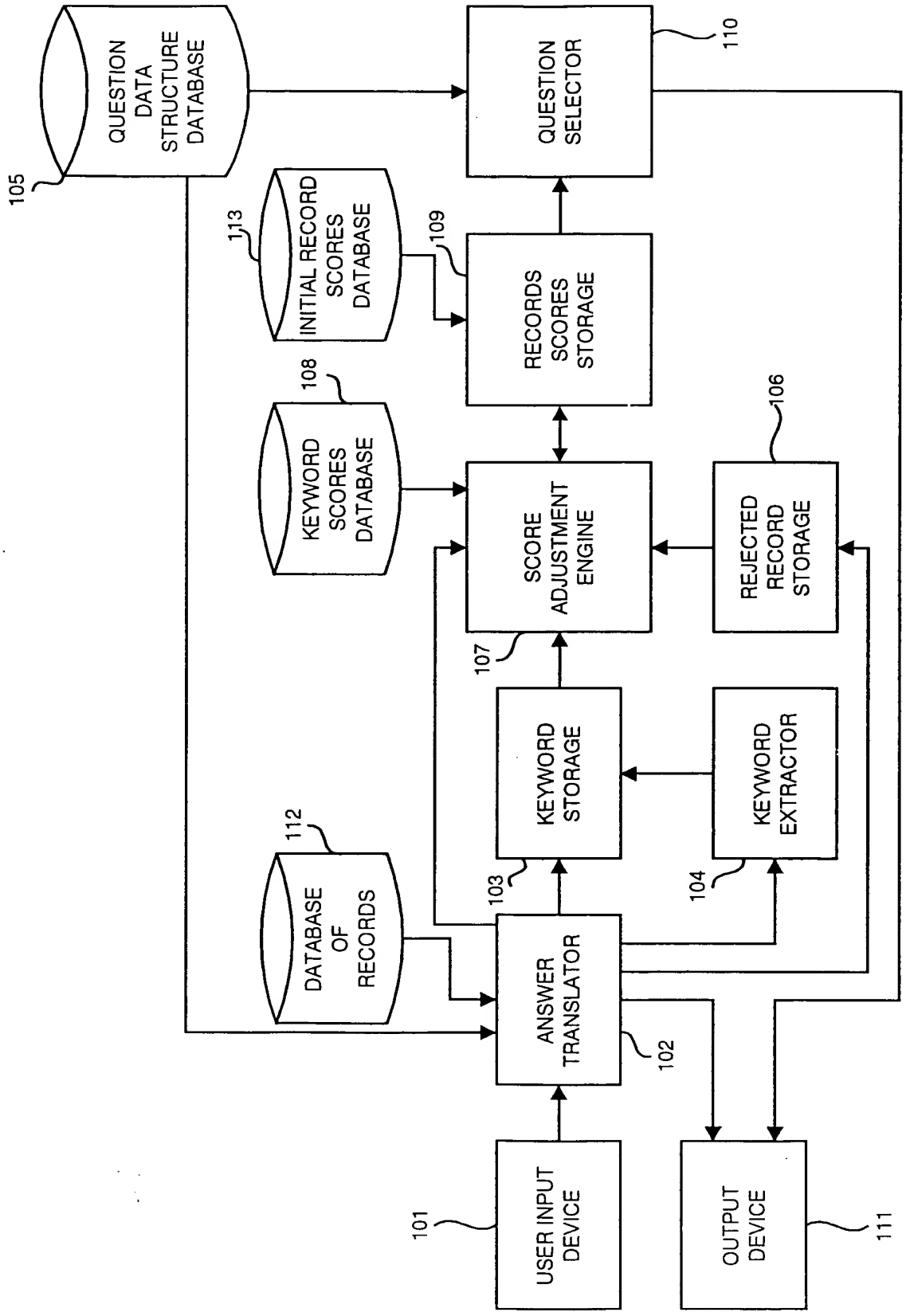
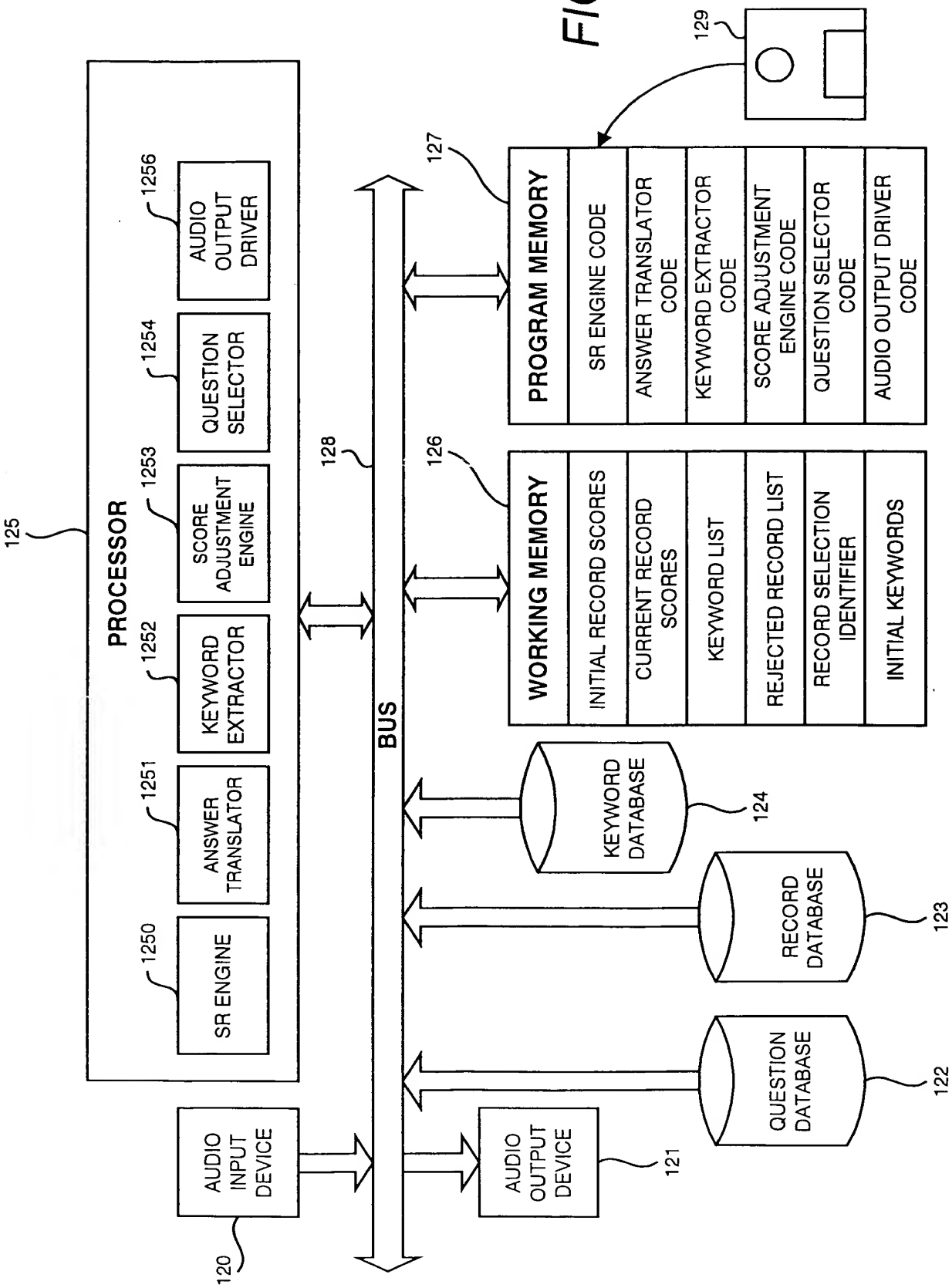

QUESTION DATA STRUCTURE DATABASE
105
QUESTION SELECTOR
110
INITIAL RECORD SCORES DATABASE
113
109
RECORDS SCORES STORAGE
KEYWORD SCORES DATABASE
108
SCORE ADJUSTMENT ENGINE
106
REJECTED RECORD STORAGE
107
KEYWORD STORAGE
KEYWORD EXTRACTOR
DATABASE OF RECORDS
112
103
104
ANSWER TRANSLATOR
102
USER INPUT DEVICE
101
OUTPUT DEVICE
111

FIG. 4

FIG. 5


PROCESSOR
SR ENGINE
ANSWER TRANSLATOR
KEYWORD EXTRACTOR
SCORE ADJUSTMENT ENGINE
QUESTION SELECTOR
AUDIO OUTPUT DRIVER
1250
1251
1252
1253
1254
1256
125
BUS
128
AUDIO INPUT DEVICE
120
AUDIO OUTPUT DEVICE
121
QUESTION DATABASE
122
RECORD DATABASE
123
KEYWORD DATABASE
124
WORKING MEMORY
INITIAL RECORD SCORES
CURRENT RECORD SCORES
KEYWORD LIST
REJECTED RECORD LIST
RECORD SELECTION IDENTIFIER
INITIAL KEYWORDS
126
PROGRAM MEMORY
SR ENGINE CODE
ANSWER TRANSLATOR CODE
KEYWORD EXTRACTOR CODE
SCORE ADJUSTMENT ENGINE CODE
QUESTION SELECTOR CODE
AUDIO OUTPUT DRIVER CODE
127
129

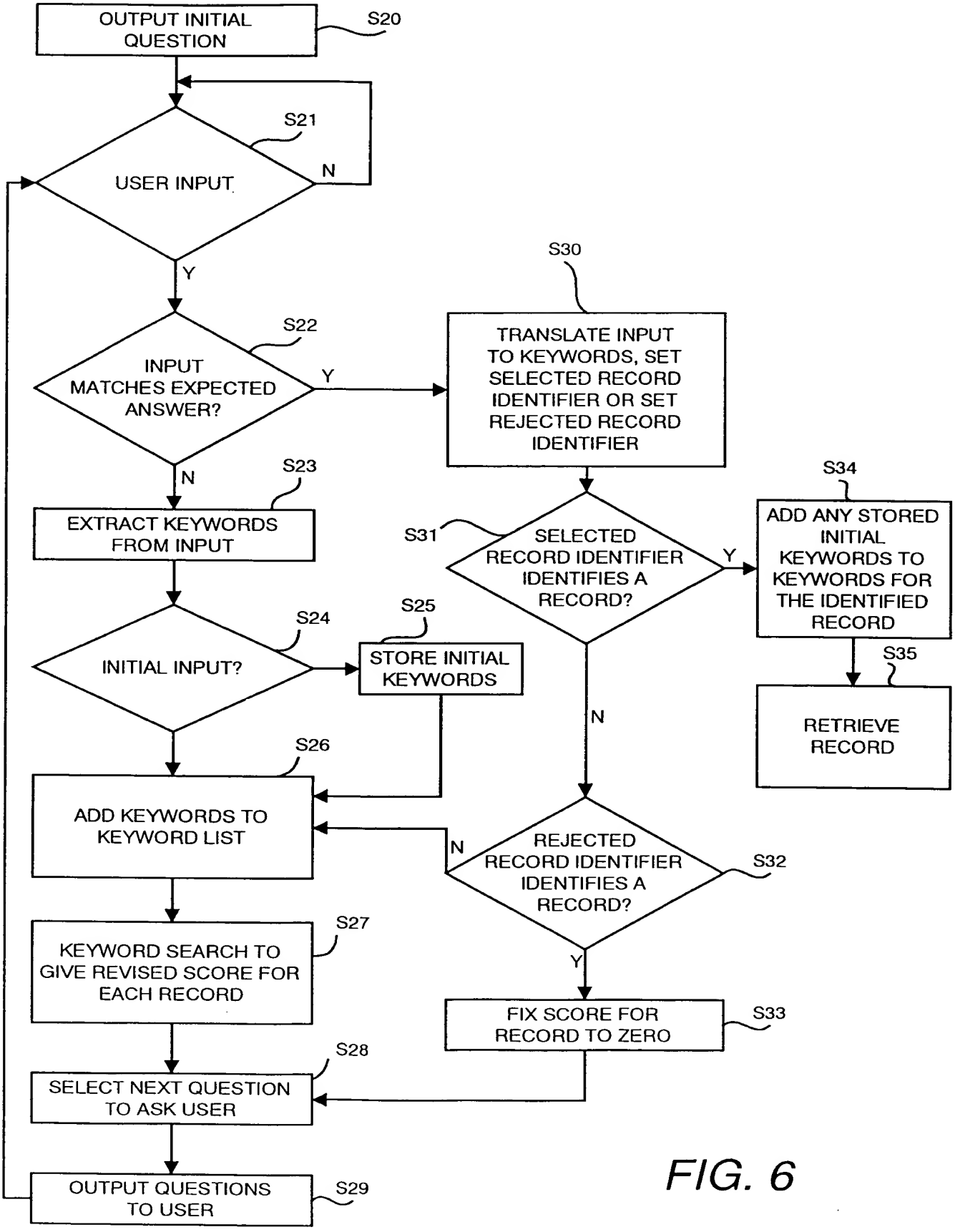

OUTPUT INITIAL QUESTION
S20
S21
USER INPUT
N
Y
S22
INPUT MATCHES EXPECTED ANSWER?
Y
N
S23
EXTRACT KEYWORDS FROM INPUT
S24
INITIAL INPUT?
S25
STORE INITIAL KEYWORDS
S26
ADD KEYWORDS TO KEYWORD LIST
S27
KEYWORD SEARCH TO GIVE REVISED SCORE FOR EACH RECORD
S28
SELECT NEXT QUESTION TO ASK USER
S29
OUTPUT QUESTIONS TO USER
S30
TRANSLATE INPUT TO KEYWORDS, SET SELECTED RECORD IDENTIFIER OR SET REJECTED RECORD IDENTIFIER
S31
SELECTED RECORD IDENTIFIER IDENTIFIES A RECORD?
Y
N
S32
REJECTED RECORD IDENTIFIER IDENTIFIES A RECORD?
N
Y
S33
FIX SCORE FOR RECORD TO ZERO
S34
ADD ANY STORED INITIAL KEYWORDS TO KEYWORDS FOR THE IDENTIFIED RECORD
S35
RETRIEVE RECORD

FIG. 6

A QUESTION DATA STRUCTURE

QUESTION NUMBER :	10
QUESTION DATA TO BE OUTPUT:	QUESTION 10.WAV
ANSWERS:	
YES:	POP MUSIC, ROCK MUSIC
NO:	REJECT RECORDS: 18, 22, 36
TOPIC:	MUSIC

FIG. 7A

A "FINAL" QUESTION DATA STRUCTURE

QUESTION NUMBER :	15
QUESTION DATA TO BE OUTPUT:	QUESTION 15.WAV
ANSWERS:	
YES:	SET SELECTED RECORD IDENTIFIER TO RECORD NO. 20
NO:	SET REJECTED RECORD IDENTIFIER TO RECORD NO. 20
TOPIC:	POP MUSIC

FIG. 7B

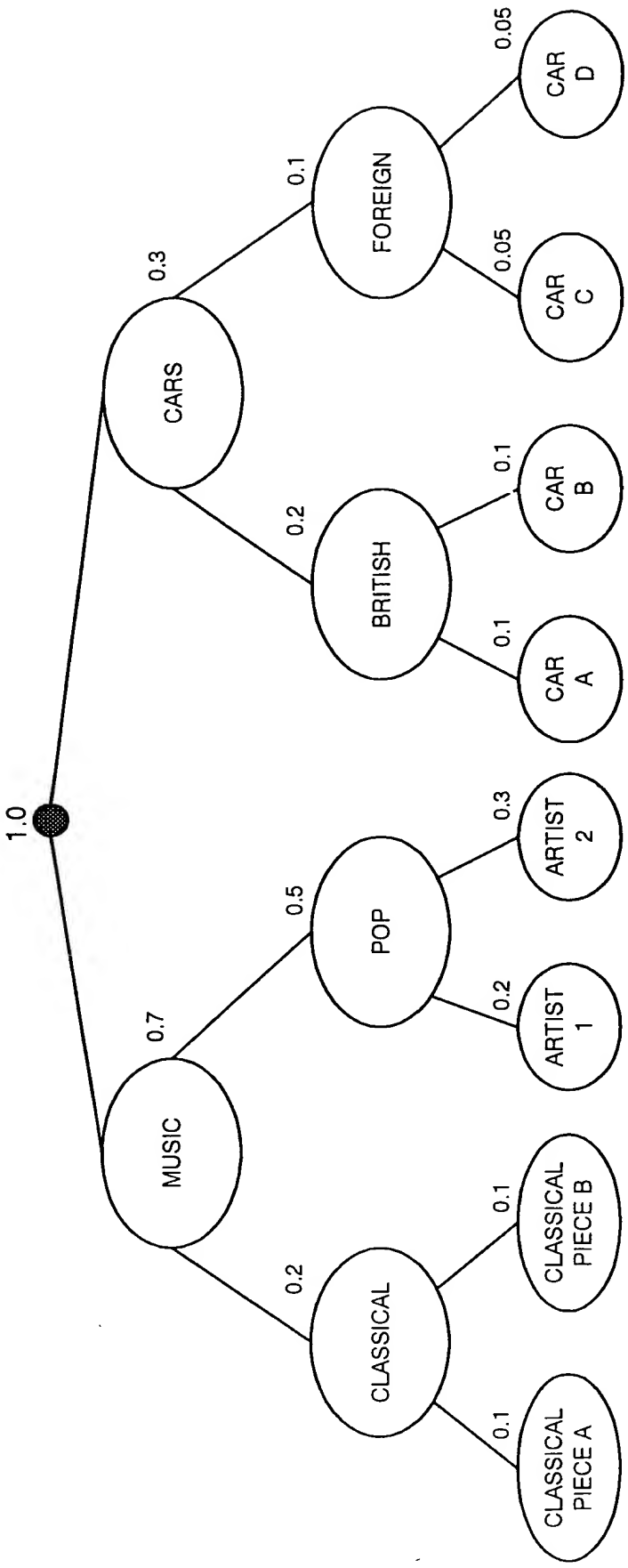

1.0
MUSIC
0.7
CLASSICAL
0.2
CLASSICAL PIECE A
0.1
CLASSICAL PIECE B
0.1
POP
0.5
ARTIST 1
0.2
ARTIST 2
0.3
CARS
0.3
BRITISH
0.2
CAR A
0.1
CAR B
0.1
FOREIGN
0.1
CAR C
0.05
CAR D
0.05

FIG. 8